

## Atomic Structure Activity

**Problem:** How do scientists determine the structure of an atom?

An atom is so small we cannot see it. Therefore, scientists must shoot atomic particles at the atom to study its structure. **Materials:** Clay atom, paper clip

### Procedure:

1. Use the paper clip to probe the atom to determine what it looks like.
2. Push the probe into or through the atom (clay model) 10 times.

### Observations and Conclusions:

1. Was your clay atom the same all the way through or did it contain a hard object?
2. What is the shape of the object?
3. How large is it?
4. Is the object in the middle of the clay? If not, where is it located?
5. Sketch the atom (your model) as you think it looks. 6. Sketch the clay atom as it really looks.
7. Was your model an accurate picture of what the actual clay atom looks like?

### Application questions

8. Why do scientists often use models to represent scientific ideas?
9. Although we cannot see the atom because it is so small, scientists have a very accurate idea of the structure of an atom. How do scientists reach their conclusions about atomic structure?

## **WebQuest: Atomic Theory Timeline**

**Introduction:** The development of the modern atomic model marks one of the greatest accomplishments and most interesting scientific stories of the last 200 years. The model and idea of the atom has changed drastically over time with many contributions and significant discoveries by philosophers and scientists. “Scientific knowledge is ever evolving, questions of yesterday inform the experiments of today, and seemingly small advances (even blunders!) can be instrumental in shaping our views of the natural world.”

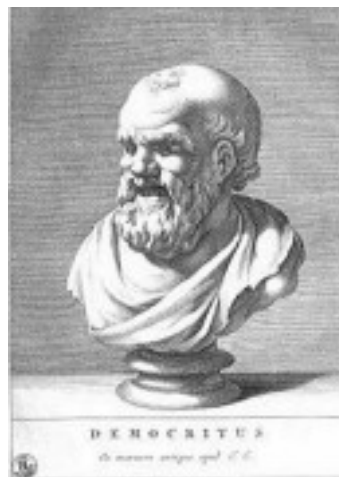
**Directions:** You will research the following contributors to the atomic theory. Use the links provided to help answer the questions.

### **Early Ideas about the Atom**

#### **Democritus- 430 BC**

Go to: [abcte.org](http://abcte.org).

1. According to Democritus’ atomic theory, the universe and all matter have the following main characteristics:



2. “Atomos” is the Greek word for \_\_\_\_\_.

#### **Aristotle- 335 BC**

1. Aristotle did not believe that matter was made up of atoms. What did he believe?



#### **The Alchemists- 700-1500 AD**

Listen to: <https://www.youtube.com/watch?v=gxiLuz9kHi0>.

1. What is alchemy?
2. What did they do?
3. Why did they do this?



### **John Dalton- 1803**



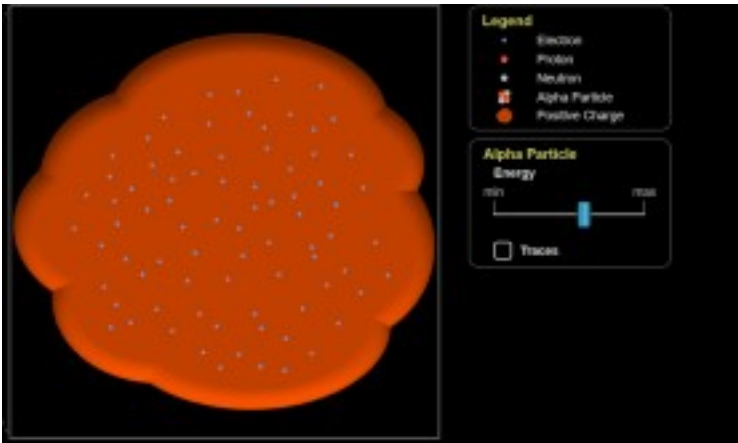
Listen to: [https://www.youtube.com/watch?v=kJ-6Qy05u\\_Q](https://www.youtube.com/watch?v=kJ-6Qy05u_Q).

1. John Dalton was the father of \_\_\_\_\_
2. What 5 contributions did he make?

### **JJ Thomson- 1897**

Listen to: <https://www.youtube.com/watch?v=Rb6MguNOUj4>

1. What types of rays did he use to determine the presence of electrons?
2. What experiment did he do? Explain what his experiment did and what it proved.



3. Go to google> Search “Plum pudding model phet”> Click on Rutherford Scattering> Hit Play> Click Plum Pudding Atom tab.

[https://phet.colorado.edu/sims/html/rutherford-scattering/latest/rutherford-scattering\\_en.html](https://phet.colorado.edu/sims/html/rutherford-scattering/latest/rutherford-scattering_en.html)

4. JJ Thomson's model of the atom is called the **Plum Pudding Model**. Draw a picture of what his model looked like. Label the charges of each area.
5. Plum pudding is a pudding often served during Christmas time in England. It is similar to our bread pudding with raisins scattered throughout the bread. How did plum pudding compare to Thomson's model of the atom?
6. Go back to the simulation. Click on the "Traces" button. Click on the blue button on the Alpha Particle machine to turn on the Alpha particles. What type of path do the Alpha particles take? Draw a picture.

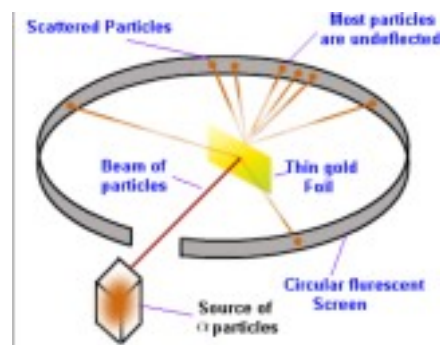
**DO NOT CLOSE OUT THE SIMULATION.**

### **Ernest Rutherford- 1910**

Listen to: [https://www.youtube.com/watch?v=5pZj0u\\_XMbc](https://www.youtube.com/watch?v=5pZj0u_XMbc)

1. What was the name of Rutherford's experiment?

2. What was the outcome of his experiment?



3. What conclusions did he make based on these experimental outcomes?

4. What did he say the atom looked like?

5. Go back to the simulation. Click on the Rutherford Atom tab.

[https://phet.colorado.edu/sims/html/rutherford-scattering/latest/rutherford-scattering\\_en.html](https://phet.colorado.edu/sims/html/rutherford-scattering/latest/rutherford-scattering_en.html)

6. Click on the “Traces” button. Set the number of protons to 60 and click on the blue button on the Alpha Particles machine. What pattern do you notice about the paths of most of the alpha particles?
7. Click on the red/gray sphere. Watch and describe how the alpha particles move in relationship to the nucleus. Make a sketch of the motion.
8. How is this different from Thomson’s experimental outcomes?
9. Alpha particles have a positive charge. Why do you think the alpha particles were repelled from the center? (Hint: Think about when a magnet repels and attracts)

### **Niels Bohr- 1913**

Go to [https://academickids.com/encyclopedia/index.php/Bohr\\_model](https://academickids.com/encyclopedia/index.php/Bohr_model).

1. What did he discover about the atom?

2. What is another name for his atomic model?

3. Draw a picture of his model.

### **James Chadwick- 1932**

Go to <http://www.pbs.org/wgbh/aso/databank/entries/dp32ne.html>

1. What makes up the atomic number?

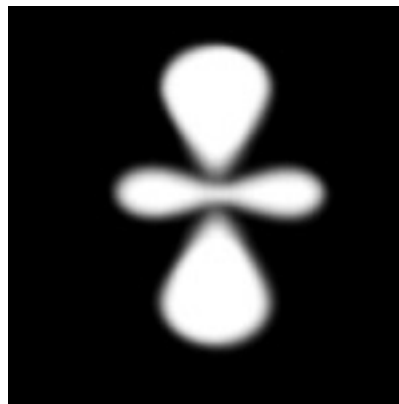


2. What makes up the atomic mass?
3. Whos experiments did Chadwick mimic his own after? What did he do?
4. What is the something-besides-just-the proton called?

### **Erwin Schrodinger- 1926**

Go to [http://www.abcte.org/files/previews/chemistry/s1\\_p6.html](http://www.abcte.org/files/previews/chemistry/s1_p6.html)

1. What is Schrodinger's model called?
2. What did he try to do?
3. Where does Schrödinger say electrons are located?



### **Atomic Basics: Fill in the answers in the table.**

[http://www.chem4kids.com/files/atom\\_structure.html](http://www.chem4kids.com/files/atom_structure.html)

3 Subatomic particles	Location within the Atom Electrical Charge
Protons	
Neutrons	
Electron	

### **Atoms and Molecules**

All matter is made of extremely small particles called atoms. Atoms are so small that no microscope, no matter how powerful, can enable us to see them. One hundred million atoms in a row would only make one inch. We know that there are only 118 different kinds of atoms. Does this

remind you of anything? You probably remember that there are 118 different kinds of elements. So therefore, each element is made of one kind of atom. You can't break an element into anything simpler. No matter how much you divide an element, you still have the same kind of atoms.

We learned that elements are the simplest kind of matter and now we see that an atom is the smallest unit of matter.

Atoms join together to form groups of atoms called molecules. Usually a molecule is made of atoms of different elements. Now we can see that compounds are made of molecules because it is two or more elements joined together.

We learned that elements combine to make compounds; what we also meant was that atoms combine to make molecules.

How do atoms combine? Atoms act like tiny magnets. They attract each other and join together. Therefore, 118 different atoms can join together many different ways to make many different molecules. That is why there are so many different compounds.

What does an atom look like? An atom is a sphere. The center of an atom is called the nucleus. In the nucleus are two particles, the proton and neutron. The proton has a positive charge, but the neutron is neutral and has no charge. Orbiting around the nucleus are negatively charged particles called electrons.

Abbreviations used to represent elements are called symbols. They are usually the first and second letter of the name of the element. Compounds are represented by chemical formulas. These formulas tell the number and kind of atoms in a compound. For example, water is  $H_2O$ , which means it has 2 atoms of hydrogen and 1 atom of oxygen.

**Fill in the blank:**

1. \_\_\_\_\_ Simplest substances.
2. \_\_\_\_\_ Smallest particles of matter.
3. \_\_\_\_\_ Substances made of 2 or more elements (joined chemically)
4. \_\_\_\_\_ The smallest particle of an element
5. Atoms join together to form \_\_\_\_\_.
6. \_\_\_\_\_ Smallest particles of a compound
7. \_\_\_\_\_ Number of different elements
8. \_\_\_\_\_ Number of different kinds of atoms
9. Therefore there is one atom for each \_\_\_\_\_
10. Atoms act like \_\_\_\_\_ when they join together.
11. An atom is shaped like a \_\_\_\_\_.
12. The center of an atom is called the \_\_\_\_\_.
13. In the nucleus there are two particles called \_\_\_\_\_ and \_\_\_\_\_.
14. Spinning around the nucleus there are negative particles called \_\_\_\_\_.
15. In one molecule of  $C_6H_{12}O_6$  (sugar) there are \_\_\_\_\_ atoms of carbon, \_\_\_\_\_ atoms of hydrogen and six atoms of \_\_\_\_\_.